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Foot Step Harvesting Energy Using Sensor's

Anjana N[1], G Sneha[2], Sudeep M C[3], Abhishek A.D[4], Mouna K M[5]
[1,2,3,4,5]Department of Electronics and Communication Engineering, BGS Institute of Technology, Adichunchanagiri University, Mandya, Karnataka, India.

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Abstract: *The footstep Power generation and its use is one of the issues. Now-a- day's numbers of power sources are present, nonrenewable & renewable, but still we can't overcome our power needs. Among these human population is one of the resources. In this project we are doing generation of power by walking or running. Power can be generated by walking on the stairs. The generated power will be stored and then we can use it for domestic purpose. This system can be installed at homes, schools, colleges, where the people move around the clock. When people walk on the steps or that of platform, power is generated by using weight of person. The control mechanism carries piezoelectric sensor, this mechanical energy applied on the crystal into electrical energy. When there is some vibrations, stress or straining force exert by foot on flat platform. This output is provided to our monitoring circuitry which is micro controller-based circuit that allow user to monitor the voltage and charges a battery, and this power source has many applications. The project model is cost effective and easy to implement.*

Key Word : *Piezoelectric Sensor, Energy Harvesting, Footstep Power Generation, Kinetic energy IR Sensor, LDR Sensor, Battery, Mobile Charging, Street Lights, EV vehicles, LCD Display.*

I.INTRODUCTION

The world is facing an energy crisis linked to environmental degradation, climate change, and the depletion of fossil fuels, highlighting the urgent need for alternative solutions. Renewable energy sources like solar, wind, and kinetic energy are becoming popular due to their low environmental impact. Among these, solar energy is widely adopted, but its infrastructure needs can limit its use. Simultaneously, the rise of electric vehicles (EVs) is driving demand for sustainable charging methods, as conventional grid-based charging can be costly and environmentally harmful. This project aims to develop an innovative charging system by harnessing energy from human footsteps using piezoelectric materials and solar energy, offering a sustainable alternative to traditional EV charging. By integrating wireless power transmission controlled by RFID, this system provides efficient, eco-friendly charging without relying on the grid. The use of footstep energy harvesting in high-traffic areas like malls and airports can generate electricity from human motion, supporting smart cities and reducing battery dependence for wearable devices and sensors.

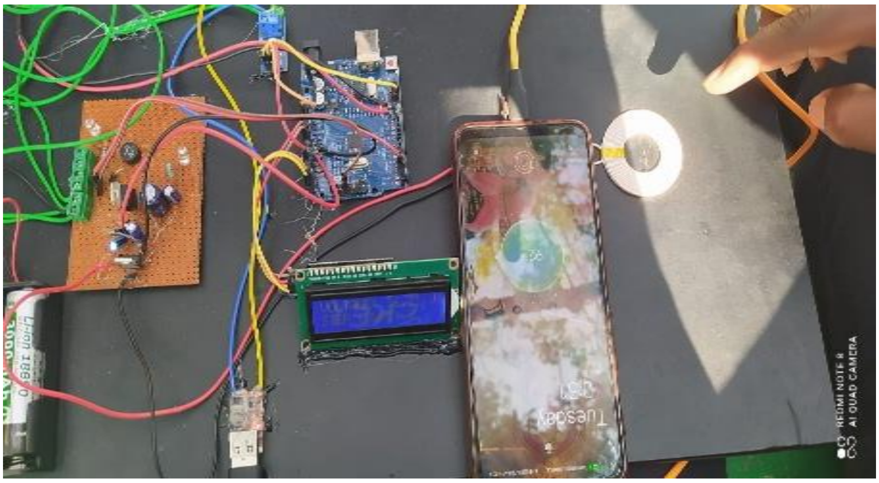

Fig1: complete model of the project

II. LITERATURE SURVEY

A. Electricity Generation from Footsteps, a Regenerative Energy Resource:

In 3 March 2013 Tom Jose v [1] had developed a system for electricity generation from footstep .it is Microcontroller based model for generating electricity it can be used anywhere using Piezo electric sensors. This power is generating in ac form so we need rectifier circuit to store the power.

B. Piezoelectric Power Scavenging of Mechanical Vibration Energy:

In 4 Oct 2007 U.K Singh and R.H. Middleton [2] has developed a system "piezoelectric power scavenging of mechanical vibration energy" here they are using same principle. When mechanical force is applied on Piezo sensors it generates power in ac form so we need to store this power in dc form and also, we need booster circuit.

C. Generation of Electrical Power through Footsteps:

In 2011 Mechatronics (ICOM) 4th International conference by fakhzan, M.N., Muthalif, A.G.A. [3] their using same principle. Example (1) A beam with piezo ceramic patches have been used as a method to harvest energy. (2) A unimorph piezoelectric cantilever beam generates electric current or voltage from the piezoelectric strain effect.

D. Vibration-Based Energy Harvesting Using Piezoelectric Materials:

In 20 sept 2014 Generation of electric power through Footsteps [4] k .Ramakrishna, Guruswamy Revana and venu Madhav Gopaka International journal of multidisciplinary and current Research. Their using same principle. Example (1) Diaphragm movement in certain material will cause generation of electric charge. (2) Pressure polarizes some crystals, such as quartz.

III. EXISTING SYSTEM

In existing systems, we are using solar and wind to generate power. These have some disadvantages. Solar will work up to sunset after that we can't generate power as much as we generated will sun. In wind energy we won't get that much wind which is required to generate power all the time.

Proposed system Electricity has become lifeline for human population. Demand of electricity is increasing day by day. Some technology needs high amount of electrical power to perform various operations. As we know electricity is generated by some sources like water, wind etc. To generate the electricity from these resources, development of big plants or big mills is needed having high maintenance cost. As the use of energy is increases, no of energy resources are generated and wasted. If the wastage of energy is rapidly increases then one day will come at that time we will face totally absence of energy. When was stored the energy then IR sensor detected power transmission to coils and based on LDR sensor LEDs on and RFID reader acts as mobile charger on.

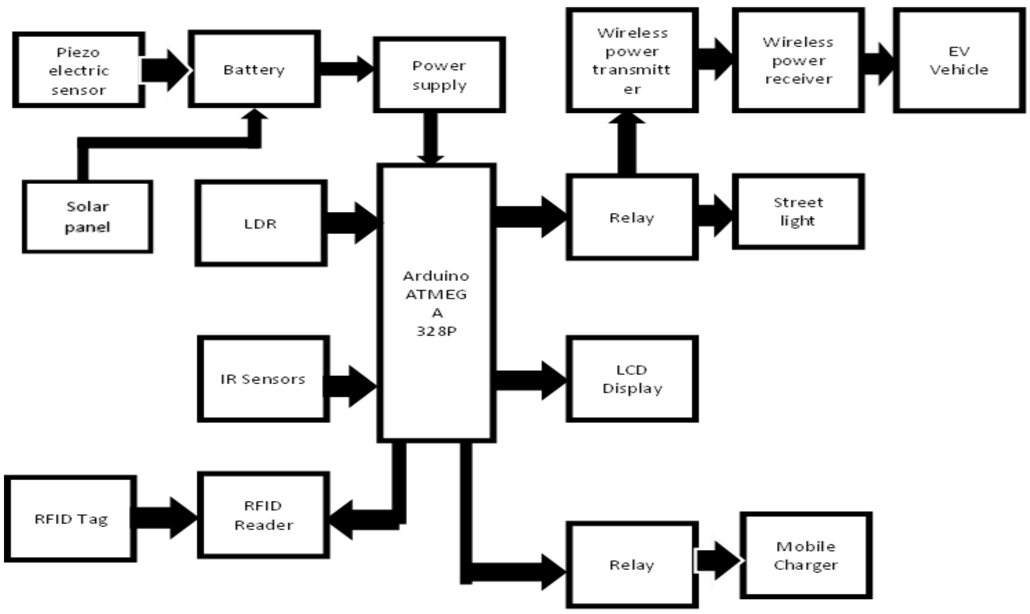

Fig2: Block Diagram of foot step harvesting energy using sensor

The system leverages a piezoelectric sensor to convert the kinetic energy from footsteps into electrical energy, which is then stored in a battery. This energy powers an Arduino microcontroller that processes data from various sensors, including light and infrared sensors. Based on this information, the Arduino controls connected devices, such as street lights and mobile chargers. The system also incorporates RFID technology for identification and authentication, as well as wireless power transfer for devices like electric vehicles and mobile phones. This innovative approach demonstrates the practical application of renewable energy and smart technology, promoting energy sustainability and providing convenient solutions for powering various devices.

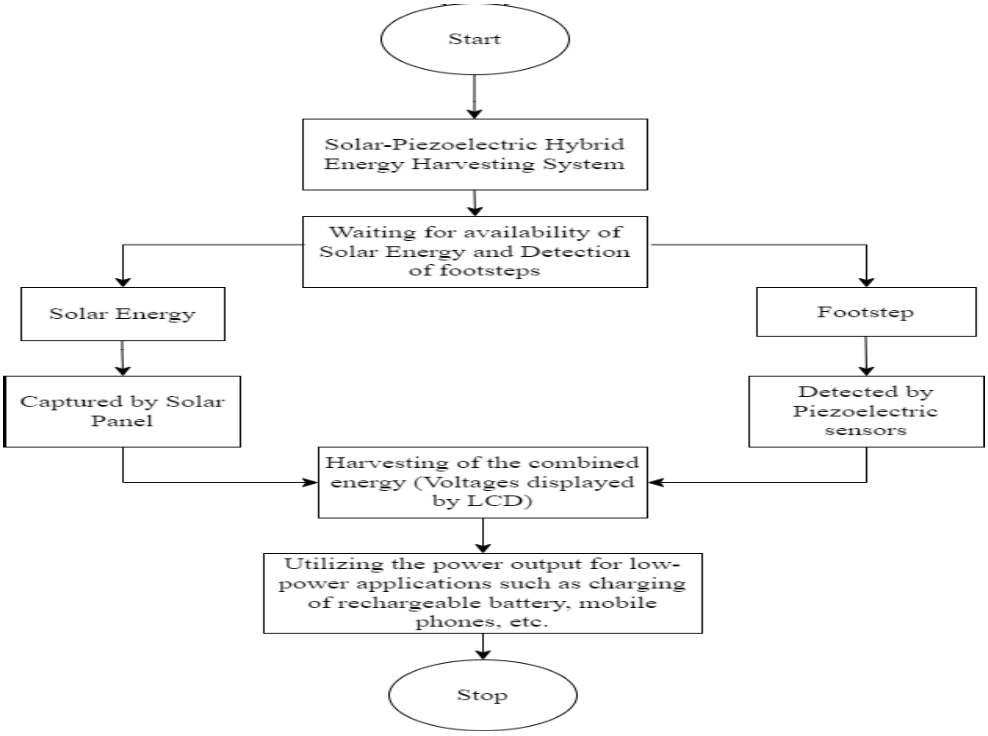

Fig3: Flow Chart

The flowchart shown in Fig3, The flowchart describes an autonomous hybrid energy-harvesting system that combines solar and piezoelectric sources to power low-consumption electronics. Upon startup, the system brings its photovoltaic array and piezoelectric pads online and immediately begins a continuous dual-monitoring routine. It simultaneously assesses ambient light levels and detects footstep-generated vibrations. When sunlight exceeds a preset threshold, the MPPT-equipped charge controller captures and optimizes the solar output. In parallel, mechanical flexing of the piezoelectric elements generates AC pulses, which are then rectified and smoothed into DC. Both energy streams are funnelled into the central harvesting bus via diode-OR circuitry, ensuring seamless merging without back-feeding one source into the other.

At the convergence point, a microcontroller samples the resulting DC voltage and provides real-time feedback via an onboard LCD display. This allows users or maintenance personnel to monitor harvested voltage levels and battery charge status at a glance. A rechargeable battery bank stores the accumulated energy, while firmware-defined thresholds guard against overcharge and deep-discharge conditions. Status LEDs convey charging activity and power-low warnings, and USB charging ports are enabled only when sufficient energy is available. The intelligent firmware also prioritizes critical loads—such as safety lighting—over optional services when overall power reserves are limited.

The Following each charge cycle, the system allocates stored energy to practical low-power tasks: mobile-device charging, IoT sensor operation, and indicator lighting. Once these loads complete, control smoothly returns to the idle monitoring state, maintaining perpetual readiness for the next influx of sunlight or footsteps. Because the entire sequence loops without human intervention and relies solely on harvested energy, the design delivers uninterrupted off-grid power to essential microloans. This resilient, self-contained architecture exemplifies sustainable energy management for remote installations, emergency deployments, and any scenario where mains electricity is unavailable or undesirable.

IV. IMPLEMENTATION

Footstep energy harvesting using sensors involves capturing mechanical energy from footsteps and converting it into electrical energy. This is achieved through piezoelectric sensors embedded in flooring, which generate an electric charge when subjected to mechanical stress. The harvested energy can be stored in batteries or supercapacitors and used to power various application, such as Streetlights, public spaces, or smart .While challenges like efficiency, cost, and durability exist, advancements in materials and technology are paving the way for scalable and sustainable energy harvesting solutions.

V. RESULTS

Additionally, the project can promote awareness of eco- friendly practices by showcasing the potential of energy harvesting from human movement. The RFID sensor could be utilized for participant engagement, logging individual contributions. The relay might enable control over external devices based on certain conditions. This Footstep harvesting project combines technology, sustainability, and participant interaction for a multifaceted result. Furthermore, the harvested energy could power low-energy devices or charge small electronics, showcasing practical applications of sustainable energy. The LCD can display real-time data, such as energy generated or environmental metrics, fostering engagement among participants. Integration with a mobile app or cloud platform could enable remote monitoring and data analysis, expanding the project's impact beyond the immediate eco walk setting.

These systems have been able to power low-energy applications such as LED lights, digital displays, or wireless sensors, particularly in high-footfall areas. The efficiency and output of energy harvested depend on factors such as sensor type, placement density, and the force of footsteps. Studies and prototype implementations have shown that, while individual footstep energy output is relatively low, the cumulative energy in busy locations can be substantial, highlighting its potential as a supplementary power source in sustainable urban environments

(a) ***(b)*** ***(c)***

Fig 4: a) Complete model. b) EV vehicle and LCD display. c) Charging path of EV vehicle.

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VI. FUTURE SCOPE

Utilization of wasted energy is very much relevant and important for highly populated countries in future. The proposed work portrays the concept of Piezoelectric Energy Harvesting and the results obtained after the implementation are very encouraging. Future work of the proposed idea encompasses further amplification of the crystal output to a greater extent. Future lies in the inclusion of advanced material used to design the piezoelectric crystal which further amplifies the crystal output in terms of voltage as well as current. A study could be carried out from the variety of piezoelectric crystals and after comparing the results, the choice of the optimum material for the best performing crystal could be devised.

Footstep energy harvesting using sensors has promising future scope, particularly in the areas of sustainable energy generation and smart infrastructure. As urban populations grow and the demand for clean, renewable energy rises, footstep-powered systems can be integrated into high-traffic areas like train stations, airports, malls, and sidewalks to convert mechanical energy from walking into usable electrical energy. This technology can power low-energy devices such as LED lighting, sensors, or mobile chargers, and can be integrated with IoT systems for real-time data monitoring. Advancements in piezoelectric materials and energy storage systems will further enhance efficiency and durability, making the technology more viable for large-scale implementation. Additionally, its integration with smart city initiatives can contribute to environmental sustainability, energy conservation, and public awareness about renewable energy sources.

The future scope of footstep energy harvesting using sensors is highly promising as a supplementary source of renewable energy, especially in crowded public spaces. With advancements in sensor technology and energy storage, these systems can be more efficiently integrated into smart cities to power streetlights, sensors, and small electronic devices. This technology also supports sustainable development goals by reducing dependency on conventional energy sources and promoting eco-friendly innovations in infrastructure.

Footstep energy harvesting using sensors is a technology that converts the pressure from walking into electrical energy using devices like piezoelectric sensors. When people walk on specially designed floors, the sensors capture the mechanical energy and turn it into electricity. This can be used to power small devices like lights or sensors, especially in busy areas like malls, train stations, or sidewalks. It's a clean and renewable way to generate energy from everyday human activity.

Footstep energy harvesting using sensors is a method of generating electricity from the pressure and motion of people walking. It typically uses piezoelectric sensors that convert mechanical stress into electrical energy. This energy can power small devices like lights or sensors. In the future, it could be used in public places to support smart city infrastructure and reduce reliance on traditional energy.

VII. CONCLUSION

In conclusion, footstep energy harvesting using sensors presents an innovative and sustainable approach to generating electricity from daily human activity. By harnessing the mechanical energy produced during walking, this technology offers a clean, renewable, and eco-friendly energy source, particularly suited for high-traffic public areas. With continued advancements in sensor technology and integration into smart infrastructure, footstep energy harvesting holds great potential for contributing to energy efficiency and environmental sustainability in the future.

Footstep energy harvesting using sensors presents a sustainable and innovative approach to generating electricity from human movement. The study demonstrates the feasibility of converting mechanical energy from footsteps into electrical energy using piezoelectric or pressure sensors. These sensors effectively respond to the pressure exerted during walking, generating small amounts of energy that can be used to power low-energy devices such as LEDs or wireless sensors. Although the energy output per step is relatively low, it becomes significant in high foot traffic areas, making it a practical solution for smart public infrastructure. The system offers a renewable energy source that is environmentally friendly and can contribute to powering IoT devices in smart cities. Additionally, the project highlights the potential for scalability and further optimization, such as improving sensor placement, integrating energy storage systems, and exploring hybrid energy harvesting methods. Overall, footstep energy harvesting proves to be a promising area for sustainable energy research and development.

In conclusion, the "Foot step - Harvesting Energy with Every Step using Arduino Uno" project showcases an innovative and eco-conscious approach to energy generation through human motion. Through the incorporation of piezoelectric sensors and microcontroller-based technology, we have successfully demonstrated the feasibility of converting footsteps into electrical power, offering a sustainable energy solution. This project not only promotes clean and renewable energy practices but also has the potential to improve energy accessibility in various settings. While it may not fully replace conventional renewable energy sources, it represents a valuable addition to the quest for cleaner, more sustainable energy solutions, contributing.

In closing, footstep energy harvesting is an innovative approach that can make a significant impact on energy efficiency in urban environments. As technology improves, this method of power generation could become a key component of green energy strategies worldwide.

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